Deploy ELAM to Capture VXLAN Encapsulation Packets on Nexus 7000 Series Switches

Contents

Introduction

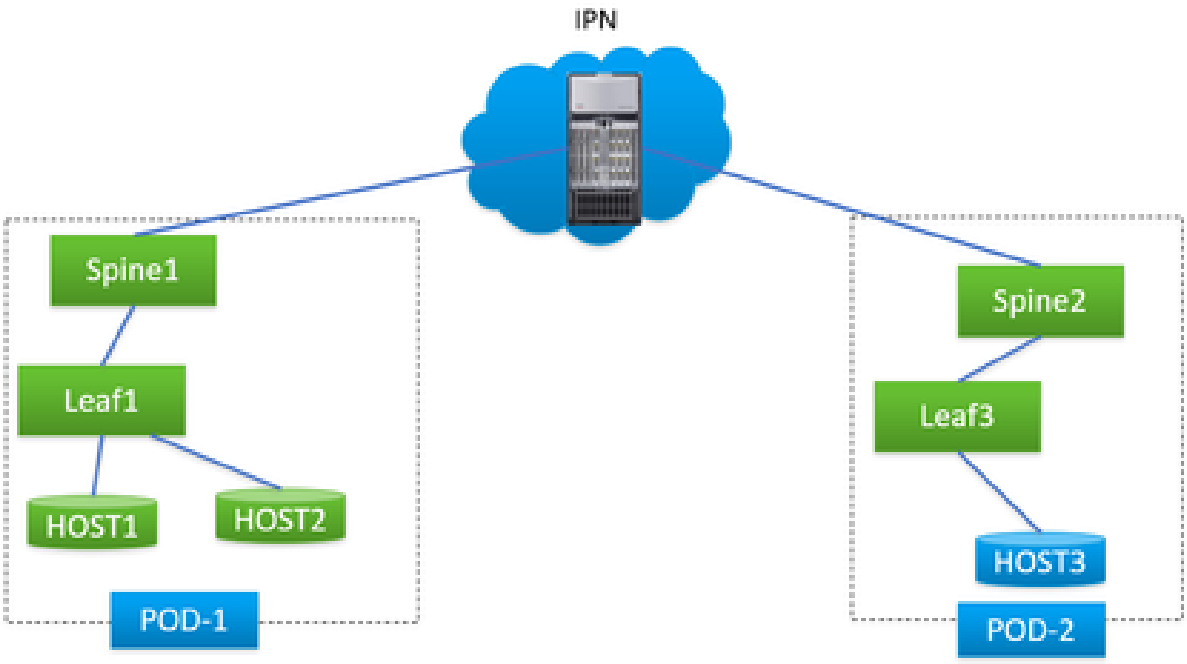
This document describes how to deploy the Embedded Logic Analyzer Module (ELAM) to capture VXLAN Encapsulation Packets on Nexus 7000 Series Switches.

Tip: Refer to the ELAM Overview document for an overview of ELAM.

Background Information

Many users are currently utilizing N7K as an IPN/ISN transit device for their ACI MPOD/MSITE deployment. However, when compared to N9K, N7K lacks the robust capability to set the ELAM trigger based on a rich Outer(l2(vntag)|l3|l4)-inner(l2|l3|l4)-ieth combination. As a result, it becomes challenging to determine if a specific VXLAN-encapsulated packet is hitting the N7K at the IPN edge from an ELAM perspective. This document outlines a method to address this challenge.

Topology



In this scenario, a straightforward ACI MPOD topology is illustrated, where IPN is an N7K with an F3 card. HOST1 and HOST2 are in pod1, HOST3 is in pod2. HOST1 can communicate with HOST3, but HOST2 cannot. Following troubleshooting conducted by an ACI engineer, it was determined that the packets from HOST2 to HOST3 were sent out to N7K from spine1 in pod1 but were never received by spine2 in pod2. This was verified through ELAM on ACI spines, leading to the suspicion that the packets were being dropped on N7K.

Is it possible to definitively attribute the issue to the N7K based solely on the ELAM results on ACI spines? Certainly not. The ELAM on egress spine1 indicated that it sent the packet to N7K, but this does not guarantee that the packet physically reached N7K, as packets may still be dropped after the ELAM cycle due to lower-layer issues. However, when you ELAM these specific packets on the N7K side, it can assist us in accurately identifying the correct device involved in the issue.

Configure the Trigger

'l3-packet-length' is a valid ELAM trigger for nearly all different generation LCs on the N7K platform. Therefore, let's utilize it to establish the ELAM condition on the IPN N7K. The task involves controlling the HOST to transmit testing packets with a specified packet length, as illustrated:

```
<#root>

#

ping 172.28.1.20 packet-size 777


PING 172.28.1.20 (172.28.1.20): 777 data bytes

785 bytes from 172.28.1.20: icmp_seq=0 ttl=252 time=1.246 ms

785 bytes from 172.28.1.20: icmp_seq=1 ttl=252 time=0.846 ms

785 bytes from 172.28.1.20: icmp_seq=2 ttl=252 time=0.84 ms
```

```
785 bytes from 172.28.1.20: icmp_seq=3 ttl=252 time=0.814 ms

785 bytes from 172.28.1.20: icmp_seq=4 ttl=252 time=0.817 ms



--- 172.28.1.20 ping statistics ---

5 packets transmitted, 5 packets received, 0.00% packet loss

round-trip min/avg/max = 0.814/0.912/1.246 ms
```

The PING utility is integrated into any type of OS, with only slight variations in parameters based on the OS you are using. One crucial point to highlight is to pay attention to the packet size you specify when initiating the PING in your OS. In this example, the 777B represents the pure data length, requiring an additional 8B (ICMP header) and 20B (IP header) to obtain the final IP length of 805B. After VXLAN encapsulation (adding an extra 50B overhead), you can anticipate the packet hitting the N7K at 855B. Let's configure it in ELAM.

In this example, the interface that connects to spine1 is E7/1 and E7/4 connects to spine2.

```
<#root>

#

show module 7


Mod  Ports  Module-Type                         Model              Status

---  -----  ---------------------------------- ------------------ ----------

7    12     10/40 Gbps Ethernet Module          N7K-F312FQ-25      ok



module-7#

show hardware internal dev-port-map


--------------------------------------------------------------

CARD_TYPE:       12 port 40G

>Front Panel ports:12

--------------------------------------------------------------

 Device name             Dev role              Abbr num_inst:

--------------------------------------------------------------

> Flanker Eth Mac Driver DEV_ETHERNET_MAC       MAC_0  6
```

```
> Flanker Fwd Driver     DEV_LAYER_2_LOOKUP     L2LKP  6
> Flanker Xbar Driver    DEV_XBAR_INTF          XBAR_INTF 6
> Flanker Queue Driver   DEV_QUEUEING           QUEUE  6
> Sacramento Xbar ASIC   DEV_SWITCH_FABRIC      SWICHF 1
> Flanker L3 Driver      DEV_LAYER_3_LOOKUP     L3LKP  6
> EDC                    DEV_PHY                PHYS   2
+--------------------------------------------------------------------------+
+----------------+++FRONT PANEL PORT TO ASIC INSTANCE MAP+++------------+
+--------------------------------------------------------------------------+
FP port |  PHYS | MAC_0 | L2LKP | L3LKP | QUEUE |SWICHF

1               0       0       0       0       0

   2               0       0       0       0       0
   3               1       1       1       1       0
   4               1       1       1       1       0
   5       0       2       2       2       2       0
   6       0       2       2       2       2       0
   7       1       3       3       3       3       0
   8       1       3       3       3       3       0
   9               4       4       4       4       0
   10              4       4       4       4       0
   11              5       5       5       5       0
   12              5       5       5       5       0
+--------------------------------------------------------------------------+
+--------------------------------------------------------------------------+
```

So, you need to set it up in instance 0.

<#root>

```
module-7# elam asic flanker instance 0
```

```
module-7(fln-elam)# layer2
module-7(fln-l2-elam)#
trigger dbus ipv4 ingress if l3-packet-length 855

module-7(fln-l2-elam)#
trigger rbus ingress if trig

module-7(fln-l2-elam)# start
module-7(fln-l2-elam)# status
ELAM Slot 7 instance 0: L2 DBUS Configuration: trigger dbus ipv4 ingress if l3-packet-length 855
L2 DBUS: Triggered
ELAM Slot 7 instance 0: L2 RBUS Configuration: trigger rbus ingress if trig
L2 RBUS: Triggered
```

Interpret the Results

```
<#root>
module-7(fln-l2-elam)#
show dbus

cp = 0x10084d00, buf = 0x10084d00, end = 0x10091050
------------------------------------------------------------------
Flanker Instance 00 - Capture Buffer On L2 DBUS:

Status(0x1102), TriggerWord(0x000), SampleStored(0x008),CaptureBufferPointer(0x000)

is_l2_egress: 0x0000, data_size: 0x023
[000]: 14f4a000 08010000 00000000 6d200800 00006000 00000000 01800100 00000000 00000000 00000000 000030
0590 00990000 00000000 00000000 00000005 88405000 00000000 00000000 00000000 00000000 00000000 00000000
a4 2dbeef00
Printing packet 0
```

```
------------------------------------------------------------------

                      L2 DBUS PRS MLH IPV4

------------------------------------------------------------------

label-count          : 0x0             mc                   : 0x0

null-label-valid     : 0x0             null-label-exp       : 0x0

null-label-ttl       : 0x0             lbl0-vld             : 0x0

lbl0-eos             : 0x0             lbl0-lbl             : 0x0

lbl0-exp             : 0x0             lbl0-ttl             : 0x0

lbl1-exp             : 0x0             lbl1-ttl             : 0x0

ipv4                 : 0x0             ipv6                 : 0x0

l4-protocol          : 0x11
           df                  : 0x0
mf                   : 0x0             frag                 : 0x0

ttl                  : 0x1f            l3-packet-length     : 0x357


option               : 0x0             tos                  : 0x0

sup-eid              : 0x0             header-type          : 0x1

error                : 0x0             redirect             : 0x0

port-id              : 0x0             last-ethertype       : 0x800

l2-frame-type        : 0x0             da-type              : 0x0

packet-type          : 0x0             l2-length-check      : 0x0

ip-da-multicast      : 0x0             ip-multicast         : 0x0

ip-multicast-control: 0x0              ids-check-fail       : 0x0

tr                   : 0x0             outer-cos            : 0x0

inner-cos            : 0x0             vqi-valid            : 0x0

vqi                  : 0x0             packet-length        : 0x369

vlan                 : 0x4             destination-index    : 0x0

source-index         : 0x30
           bundle-port         : 0x0
acos                 : 0x0             outer-drop-eligibility: 0x0
```

```
inner-drop-eligibility: 0x0             sg-tag              : 0x0
rbh                 : 0x0             vsl-num             : 0x0
inband-flow-creation-deletion: 0x0             ignore-qoso         : 0x0
ignore-qosi         : 0x0             ignore-aclo         : 0x0
ignore-acli         : 0x0             index-direct        : 0x0
no-stats            : 0x0             dont-forward        : 0x0
notify-index-learn  : 0x1             notify-new-learn    : 0x1
disable-new-learn   : 0x0             disable-index-learn : 0x0
dont-learn          : 0x0             bpdu                : 0x0
ff                  : 0x0             rf                  : 0x0
ccc                 : 0x0             l2                  : 0x0
rdt                 : 0x0             dft                 : 0x0
dfst                : 0x0             status-ce-1q        : 0x0
status-is-1q        : 0x1             trill-encap         : 0x0
mim-valid           : 0x0             dtag-ttl            : 0x0
dtag-ftag           : 0x0             valid               : 0x1
erspan-kpa-valid    : 0x0             recir-shim-vxlan-src-peer-id: 0x0
vn-valid            : 0x0             source-vif          : 0x0
destination-vif     : 0x0             vn-p                : 0x0
sequence-number     : 0x60            vl                  : 0x0
inner-de-valid      : 0x0             de-cfi              : 0x0
second-inner-cos    : 0x0             tunnel-type         : 0x2
-----------------------------------------------------------------------

                      UDP OTV/LISP TUNNEL BNDL

-----------------------------------------------------------------------
vlan-tag-valid: 0x0             segment-id-valid: 0x0
vl: 0x0             de: 0x0
sgt-valid: 0x0             inner-ip-ttl: 0x0
ip-da-multicast: 0x0
lisp-inst-id: 0x2c8004

lisp-flags: 0xc8            isis-mac-da-valid: 0x0
```

```
type: 0x0

shim-valid          : 0x0

segment-id-valid    : 0x0             copp                : 0x0

dti-type-vpnid      : 0x0             segment-id          : 0x0

ib-length-bundle    : 0x58840         mlh-type            : 0x5

ulh-type            : 0x4
```

source-ipv4-address: 10.0.200.64

destination-ipv4-address: 10.1.224.67

```
mim-destination-mac-address : 0000.0000.0000

mim-source-mac-address : 0000.0000.0000

destination-mac-address : 00c1.b1c9.c2c4

source-mac-address : 000d.0d0d.0d0d
```

Because l3 packet length is used as the trigger, there is a possibility that the ELAM could be triggered by background packets unintended for capture. Therefore, it is imperative to utilize other fields in the capture for a double cross-check of the capture results. This ensures that the captured packet aligns with our intended criteria, including fields like source IP (sip), destination IP (dip), time-to-live (ttl), source index, etc. An interesting observation is that, although N7K doesn't support using VXLAN VNID as a trigger, in the output interpreter, the field 'lisp-inst-id: 0x2c8004' corresponds to the VNID in the VXLAN header.

<#root>

```
module-7(fln-l2-elam)# dec
```

0x2c8004

2916356

```
Leaf3#
```

show system internal epm endpoint ip 172.28.1.20

```
MAC : 0000.2222.1202 ::: Num IPs : 1
```

```
IP# 0 : 172.28.1.20 ::: IP# 0 flags : host-tracked| ::: l3-sw-hit: Yes ::: flags2 :

Vlan id : 186 ::: Vlan vnid : 11494 ::: VRF name : zixu:vrf

BD vnid : 16482209 :::

VRF vnid : 2916356

/* Confirming the VNID from ACI LEAF side */

Phy If : 0x1a00b000 ::: Tunnel If : 0

Interface : Ethernet1/12

Flags : 0x80005c04 ::: sclass : 16388 ::: Ref count : 5

EP Create Timestamp : 01/22/2021 15:42:49.243582

EP Update Timestamp : 02/08/2021 11:26:52.882308

EP Flags : local|IP|MAC|host-tracked|sclass|timer|

module-7(fln-l2-elam)#

show rbus


cp = 0x100a96fc, buf = 0x100a96fc, end = 0x100b5a4c

---------------------------------------------------------------------

Flanker Instance 00 - Capture Buffer On L2 RBUS:


Status(0x1102), TriggerWord(0x000), SampleStored(0x008),CaptureBufferPointer(0x000)


is_l2_egress: 0x0000, data_size: 0x018

[000]: 0015cb30 0000006d 20000000 03000000 00000000 00000000 00000014 2d8000a0 3c3c0000 00000000 020000

0000 00000400 00008000 005d0000 001e0002 2bd7c0cf f96002a0 000000ba

Printing packet 0

---------------------------------------------------------------------

                      L2 RBUS INGRESS CONTENT

---------------------------------------------------------------------

pad                 : 0x572c          valid               : 0x1

l2-rbus-trigger     : 0x1             sequence-number     : 0x60

rit-ipv4-id         : 0x0             ipv4-tunnel-encap   : 0x0
```

```
rit-mpls-rw         : 0x0            ml2-ptr             : 0x0
ml3-ptr             : 0x0            mark                : 0x0
result-cap3         : 0x0            di1-v5-delta-length : 0x0
di1-v5-delta-length-plus: 0x0            di1-v4-delta-length : 0x0
di1-v4-delta-length-plus: 0x0            di2-delta-length    : 0x0
di2-delta-length-plus: 0x0            ml2-delta-length    : 0x0
ml2-delta-length-plus: 0x0            ml3-delta-length    : 0x0
ml3-delta-length-plus: 0x0            s-vector            : 0x0
lcpu-ff-valid       : 0x0            sup-di-vqi          : 0x0
erspan-term-index-dir: 0x0            erspan-buffer-check : 0x0
l2-tunnel-decapped  : 0x0            l3-delta-length     : 0x0
rit-crc16-valid     : 0x1            rit-crc16           : 0x42d8
vntag-p             : 0x0            frr-recirc          : 0x0
ingress-lif         : 0x5            earl-proxy-vld      : 0x0
md-di-vld           : 0x0            rc                  : 0x0
segment-id-valid    : 0x0            ttl-out             : 0x1e
ttl-mid             : 0x1e           tos-out             : 0x0
tos-in              : 0x0            orig-vlan1          : 0x0
vlan1               : 0x0            source-peer-id      : 0x0
final-ignore-qoso   : 0x0            port-id             : 0x0
cr-type             : 0x1            pup-packet          : 0x0
bpdu                : 0x0            vdc                 : 0x0
tr                  : 0x0            de                  : 0x0
cos                 : 0x0            inner-drop-eligibility: 0x0
inner-cos           : 0x0            acos                : 0x0

di-ltl-index        : 0x3c
            l3-multicast-di     : 0x3c
source-index        : 0x30           vlan                : 0x4
index-direct        : 0x0            di1-valid           : 0x1
vqi                 : 0x4a           di2-valid           : 0x0
v5-fpoe-idx         : 0x0            di2-fpoe-idx        : 0x0
```

```
l3-multicast-v5     : 0x0            dft                 : 0x0
dfst                : 0x0            l3-learning-ff      : 0x0
result-rbh          : 0x40           di2-cr-type         : 0x0
result-2            : 0x1            dtag-ftag           : 0x0
dtag-ttl            : 0x20           mac-in-mac-op       : 0x0
dvif                : 0x0            result-cap1         : 0x0
result-cap2         : 0x0            erspan-term         : 0x0
erspan-decap        : 0x0            dont-learn          : 0x0
routed-frame        : 0x1            copy-cause          : 0x0
l2-copy-cause       : 0x0            l3-rit-ptr          : 0x5d
sg-tag              : 0x0            trill-nh-id         : 0x0
ttl-in              : 0x1e           fc-up               : 0x0
up-did              : 0x0            did                 : 0x22bd
up-sid              : 0x0            sid                 : 0xf819ff
shim-l2-tunnel-encap: 0x0            shim-ls-hash        : 0xb
shim-rc             : 0x0            shim-lif            : 0x5
shim-replication-pkt: 0x0            shim-router-mac     : 0x1
shim-mark-enable    : 0x0            shim-qos-group-id   : 0x0
shim-destination-table-index: 0x5d           shim-acos-preserve  : 0x0
mim-destination-mac-address : 0000.0000.0000
mim-source-mac-address : 0000.0000.0000


module-7(fln-l2-elam)#
show system internal pixmc info ltl-cb ltl 0x30

 ltl   | ltl_type | if_index | lc_type | vdc | v4_fpoe | v5_fpoe | base_fpoe_idx | flag
0x0030 |    5     |
Eth7/1
   |   2    |  4   |  0x00   |  0x00   |    0x0000     | 0x0
```

```
module-7(fln-l2-elam)#
show system internal pixmc info ltl-cb ltl 0x3c


 ltl   | ltl_type | if_index | lc_type | vdc | v4_fpoe | v5_fpoe | base_fpoe_idx | flag

0x003c |    5     |
Eth7/4
     |   2    |  4   |  0x00   |  0x00   |     0x0000     | 0x0
```

The same methodology also works if you try to capture Broadcast, Unknown Unicast, and Multicast (BUM) packets within an ACI flooding BD, you just need to set a static ARP and point to a nonexistent MAC on your HOST, then launch the PING in the same way.

Related Information

You can refer to these links for more details on how to use ELAM on different N7K LCs:

- ELAM Overview
- N7K M-Series Module ELAM Procedure
- N7K F1 Module ELAM Procedure
- N7K F2 Module ELAM Procedure
- N7K F3 Module ELAM Procedure
- N7K M3 Module ELAM Procedure
- **Cisco Technical Support & Downloads**